

The IntelliMagic Class on I/O Subsystems Architecture & Performance Analysis for z/OS

Taught By: Dr. Gilbert Houtekamer, co-author of “MVS I/O Subsystems”, and Andries (Dries) de Jong

Register: For registration or information on course dates and locations, please visit:

<http://www.intellimagic.net/en/doc.phtml?p=Classes>



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About the instructors:

This class has been developed by Dr. Gilbert Houtekamer and Andries de Jong.

The standard reference text on MVS I/O, “MVS I/O Subsystems”, was written by Dr. Gilbert Houtekamer together with Dr. H. Pat Artis.

Dr. Gilbert Houtekamer is one of the founders of IntelliMagic, a Dutch storage performance management software company. He holds a Ph.D. from the Delft University of Technology. He has over 20 years experience in I/O performance analysis and has written numerous papers on I/O performance. Gilbert has been a frequent speaker at industry events such as CMG, SHARE and the IBM Storage Symposium. Prior to founding IntelliMagic, Gilbert was CEO and co-founder of Consul, an enterprise security software company recently acquired by IBM.

Andries de Jong started his IT career in 1968 by joining IBM Netherlands, an employment relationship that lasted until 1995. He specialized in disk subsystem performance and, since 1995, in data replication technologies. He was a member of IBM's European Advanced Technical Support team from 1996 to 2002, during which time he also participated in the IBM Geographically Dispersed Parallel Sysplex (GDPS) development team. Andries joined IntelliMagic in 2002 as an internal consultant involved in product design and documentation, developing educational materials and White Papers and being a co-developer for and a co-teacher in IntelliMagic's "I/O Subsystem Architecture and Performance Analysis for z/O" class. He did numerous presentations in international conferences, such as the yearly CMG conference and the IBM Storage Symposium.

Previous class attendees have provided these instructors with a rating of 9.2 out of 10 when asked the question about how likely they would be to recommend this class to their colleagues.

IntelliMagic's ongoing work with customers around the world and with strategic partners such as IBM means that they remain on the leading edge of knowledge regarding I/O measurement and management.

Audience

This class is designed for Enterprise Storage Professionals, Storage Architects, Storage Performance Analysts, Capacity Planning Professionals, and Systems Programmers.

Class Description

This class covers current I/O subsystem architecture for the zSeries processors running the z/OS operating system. This includes all aspects of I/O, from the fundamental zSeries hardware architecture to the implementations provided by the various vendors, and from the hardware measurement facilities to the interpretation of the RMF and SMF measurement information.

In the class you will learn how to configure your disk subsystems to best exploit their capabilities for your I/O workloads. We will discuss what RAID implementations are best for which I/O workloads, discussing the pro's and con's of RAID-10, RAID-5, RAID-6 implementations.

An impressive range of disk drives with vastly different performance characteristics is available in today's disk subsystems. In the class you will learn how to evaluate the options for your installation, so that you can make the right investment decisions.

For more and more installations a copy services implementation between the primary and secondary data center is essential. In the class we will discuss the performance planning and monitoring for synchronous (PPRC, TrueCopy, SRDF/S) and asynchronous (XRC, Global Mirror, TrueCopy, SRDF/A) implementations. With this information you will be able to size the links between your sites, and you will be able to monitor the impact of the copy services process on your I/O installation.

The class will cover the many sources of I/O measurement information available in z/OS from SMF, DFSMS and RMF. An application and I/O tuning approach will be provided, helping you to make the choices that are relevant for your workload.

Customized I/O Report and Consultation

Participants are invited to send a week's worth of RMF data to IntelliMagic before the class, of which IntelliMagic will create a free detailed I/O performance report. These reports will be reviewed during

the class. Extended consultations can also be arranged for Thursday afternoon or Friday. Please contact IntelliMagic for more details.

Class Materials

Attendees will receive a binder with over 450 detailed color slides that contain up to date content for the entire course.

Pre-Requisites

This class provides a foundational understanding of z/OS I/O architecture and performance monitoring and management. Familiarity with the z/OS environment is assumed. No knowledge of any specific tool is required. The product RMF Magic will be used on occasion to illustrate certain concepts.

Class Contents:

Day 1: Introduction, Disks and RAID

- Introduction to zSeries I/O architecture
 - How the architecture from System 360 to z/Architecture
 - Why Count-Key-Data was introduced and how it works today
 - Read and Write Disk Caching concepts
- I/O Service time in the zSeries I/O architecture
 - Introduction to service time components
 - Discussion of what contributes to IOSQ, Pending, Disconnect and Connect times
- Queuing Theory
 - Little's Law and simple queuing models
 - Relationship between utilization and response time
 - Single and multi-server queuing models
- Understanding hard disk performance
 - Performance characteristics of physical disk drives
 - When 15 k RPM drives make sense and when 300 GB drives will do.
 - Using SATA and FATA drives for mainframes applications
- RAID architectures from RAID-1 to RAID-6 and LSF
 - "A Case for Redundant Arrays of Inexpensive Disks", the RAID architecture paper from David Patterson et al
 - Reliability metrics and results for RAID
 - RAID-0, RAID-1, RAID-10, RAID-4/S, RAID-5 and RAID-6
 - Logical and Physical Device Skew
 - The Log Structured File system
 - Comparing Front-end and Back-end I/O rates for RAID subsystems

Day 2: z/OS I/O Implementation

- I/O Control flow from z/OS application to hardware
 - The layers of I/O handling: application, access method, I/O supervisor, channel subsystem, disk subsystem and hard disk drives.
 - zSeries hardware instructions
 - Channel programs and Channel Command Words
 - Locate Record, Define Extent, and Cache Controls

- Caching for z/OS
 - Read and write caching
 - Predicting cache hit probabilities
 - CKD Write caching for RAID
- I/O Subsystem Implementations
 - Host Adapters, Cache, Device Adapters and Logical resources
 - Discussion of the products from IBM, EMC, HDS and STK:
 - ESS, DS6800 and DS8000 series
 - EMC DMX Generations 1, 2, 3 and 4
 - HP XP1024 – HDS 9980V
 - HP XP12000/XP24000 – HDS USP/USP V
 - STK V2X
- Channels
 - ESCON and FICON considerations
 - Disk and Hosts perspective to channel performance
 - Contention, Open Exchanges and Effective Data Rate
- Parallel Access Volumes (PAV)
 - What are PAVs and why do they work
 - Static PAV, Dynamic PAV and HyperPAV characteristics
 - How many (hyper)PAVs do you need for your installation
 - Multiple Allegiance and I/O Priority Queuing
- I/O measurements
 - Interval and Event driven measurements in z/OS
 - SMF records with I/O related information
 - RMF record types
- Performance Management, Service Level Agreements and Tuning Objectives
 - How to define your performance objectives
 - Daily, weekly and monthly disk performance management tasks
- I/O tuning tips and tricks
 - How to use the available measurement information to achieve the most benefit
 - Configuring for performance
 - Why balancing your I/O workload gives better performance
 - Using subsystem and z/OS features to achieve I/O workload balance

Day 3: Copy Services

- Copy Services
 - Overview and the need for a consistent copy
- IBM
 - Local Replication: Flash Copy
 - Metro Mirror (PPRC)
 - Global Copy and Global Mirror
- EMC
 - Local Replication: TimeFinder Mirror, Clone and Snap
 - SRDF/S
 - SRDF/A, includes discussion of Delta Sets and Delta Set Extension
- Hitachi (HP and HDS)
 - Local Replication: Shadowimage
 - TrueCopy Synchronous Replication
 - Universal Replicator and TrueCopy Asynchronous
- SUN (Storage Tek)
 - Local Replication: Snapshot
 - PowerPPRC
- zSeries Global Mirror (XRC)
 - System Data Mover and Reader operation
 - Consistency sets
- Performance and Bandwidth Planning for Copy Services
 - Measurement information for Copy Services
 - Strategy for bandwidth sizing and monitoring

Day 4: Putting it all together

- Capacity Planning metrics for z/OS I/O
 - Factors that determine performance in modern disk subsystems
 - Front-end and Back-end bandwidth and I/O rate
 - Workload (Storage Group) or subsystem based planning
- Building Balanced Disk Subsystems
 - How to achieve maximum throughput and the best response times
 - Configuring channel adapters
 - Configuring physical disks and device adapters
 - How to monitor and manage a balanced configuration.
- The future
 - Trends in I/O Subsystem and z/OS design

- IntelliMagic's vision on I/O performance management
- Performance Reporting examples from RMF Magic
 - Overview of the RMF Magic product
 - Controlling the data reduction process
 - Data analysis capabilities and controls
 - From subsystem to device level data
 - Capabilities of the RMF Magic Windows user interface
 - Using Excel capabilities to analyze your workload
- Discuss Participant's RMF data
 - Apply class concepts to your own installation

Day 4 (after 2pm): RMF Magic Tips & Techniques

- Thursday afternoon IntelliMagic will provide a session providing an overview of RMF Magic and advanced analysis techniques and samples using the RMF Magic reporting tool.